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THE

UNIDO PROGRAMME ON TECHNOLOGICAL ADVANCES*

Note prepared by the

UNIDO Technology Programme

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Following the Third General Conference of UNIDO in 1980, a major new programme was established dealing with the implications of emerging technological advances for developing countries. Several of these technological advances are expected to alter substantially the rate and pattern of industrial production in the coming decades and will have substantial implications for achieving the Lima target of industrialization.1/

Dimensions

The question of technological advances has at least three important dimensions in relation to developing countries. First, the advances in traditional and well-established industries in different sectors need to be examined in relation to decisions on local manufacture, the potential for export, the implications for other industries etc. Thus it will be necessary to monitor long-term technological trends in sectors ranging from traditional industries, such as sugar or oils and fats, to the relatively newer industries, such as machine tools and petrochemicals, so that conscious policy decisions can be taken on the technological route that a given country wishes to follow with reference to its conditions and objectives.

Second, emerging technological advances, for example, in microelectronics and biotechnology, are not only creating new industries but have wide implications for a number of other industries. The convergence of these technological advances itself produces an interaction, which in turn has implications for the pattern and rate of industrial production in developing countries. In other words, in planning their industrial development and for achieving the Lima target, developing countries have to recognize that the present and coming decades are likely to witness substantial changes in production patterns owing to the expected interplay of the new advanced technologies. These technologies have potential as well as limitations for developing countries, and it should be part of the industrial and technological strategies of each developing country to see how it can tap the potential of the new technologies without being affected by their limitations.

The third dimension of technological advances relates to rising energy costs, which calls for particular attention to be paid to energy-related industrial technologies, for generating energy, conserving it and using it industrially.

Objectives

The UNIDO programme on technological advances was designed, in particular, to increase awareness through early identification and assessment and to promote necessary action regarding:

(a) The potential and limitations of various advanced technologies for the developing countries;

1/ The Second General Conference of UNIDO, held in Lima, Peru, in March 1975, set a target of a 25 per cent share of world industrial production for the developing countries by the year 2000.

(b) The industrial and technological capabilities that the developing countries need in order to be able to use advanced technologies where appropriate and feasible;

(c) The policy actions to be taken by the governments of developing countries with regard to advanced technologies.

In addition to expert group meetings, studies and current awareness bulletins, emphasis has been placed on:

(a) Moblizing the co-operation of individuals and institutions at the cutting edge of a particular technology;

(b) Promoting national action by developing countries in terms of policies and programmes in accordance with their conditions and requirements;

(c) Providing technical assistance, as required by developing countries.

Activities have been developed within the framework of the foregoing considerations, bearing in mind the nature of the technological advances and the type of practical action that would be most effective in each case.

Activities

1. Genetic engineering and biotechnology

At an exchange of views with experts on the implications of advances in genetic engineering for developing countries, held in Vienna from 4 to 6 February 1981, leading scientists in the field of genetic engineering and biotechnology recommended the establishment of multi-disciplinary core technical groups at the national level in developing countries and the setting up of an international centre for genetic engineering and biotechnology to provide initial impetus and support to national efforts. Subsequently, a group of experts held discussions in 16 developing and developed countries on the basis of which a proposal was drawn up for the establishment of an international centre for genetic engineering and biotechnology, with detailed recommendations on its functions, work programme and organization.

Several Governments expressed their interest in establishing and/or hosting the Centre. A high-level meeting of interested countries was held in Belgrade in December 1982, at which it was decided that an International Centre for Genetic Engineering and Biotechnology should be established. A Ministerial-level Plenipotentiary Meeting was held in September 1983 in Madrid, at which the statutes of the proposed Centre were agreed upon. In a Plenipotentiary Meeting in April 1984 it was decided to locate the Centre in two components, namely, in Trieste, Italy, and in New Delhi, India. As of February 1985 thirty-six countries had signed the statutes of the Centre. A Preparatory Committee composed of signatories of the statutes was established by the Madrid meeting. In its several sessions, the Committee took a number of steps to accelerate the establishment of the Centre, including a five-year work programme.

The Five-Year Work Programme of the Centre is expected to cover the fields of agriculture and human and animal health, which will be essentially dealt with in the New Delhi component, and industrial microbiology, energy and pilot plant activities, which will be essentially dealt with in the Trieste component. A panel of outstanding scientists was constituted to advise the Preparatory Committee on preparations. This Panel includes three Nobel Prize winners. The first meeting of the Panel took place in February 1985 in the course of which the participating Panel members exhibited significant interest in the early establishment of the Centre as a "centre of excellence", and made suggestions for enlisting the co-operation of distinguished senior scientists to provide further international scientific backing for the Centre.

The process of establishing the Centre has also resulted in significant activities at the national level in several developing countries. National centres and/or national committees for biotechnology have been established in some countries. As many as 13 member countries of the International Centre have already requested affiliation of their national centres or networks with the International Centre. These countries are Algeria, Argentina, Bulgaria, Chile, China, Cuba, Egypt, Greece, Indonesia, Mexico, Venezuela, Yugoslavia and Zaire.

In addition to the establishment of the Centre, several related activities in the field of biotechnology have been undertaken. These include the participation in the activities of a Regional Biotechnology Network for Latin America; an expert group meeting on the development and production of animal vaccines held at Stockholm in December 1981; co-sponsoring an International Symposium on Lactic Acid Fermentation in Mexico City in November 1984; participation in important international conferences, such as the International Congress on Genetics in New Delhi in 1983; the International Biotechnology Symposium in New Delhi in February 1984; and the Arab Conference on Biotechnology for Development (scheduled for May 1985); sponsoring a special workshop on capacity-building in biotechnology during the Annual Meeting of the American Association for the Advancement of Science (AAAS) in Washington in May 1984; national-level sensitization meetings with officials, scientists and technologists and industry in India and Kuwait (January 1982), Mexico (March 1982 as part of the technology perspectives project), Brazil and the Republic of Korea (November 1983); an international co-operative research and training project between the Kuwait Institute of Scientific Research and the University of Illinois; a case study on the microbial leaching of copper ore in two Andean Pact countries which has led to interest in this subject on the part of some other developing countries; a proposal for upgrading traditional fermented foods in Africa; a proposal for the establishment of a protein sweetener industry in Africa; advisory mission of experts to Egypt and Brazil; and the issue of a quarterly bulletin Genetic Engineering and Biotechnology Monitor since 1982. A study was also conducted on the state of the art of bioconversion of cellulose to ethanol, and a directory of research institutes engaged in the industrial conversion of biomass was issued in 1983. The concept of a biomass-based strategy for industrialization was developed based on the recognition that through bioconversion of renewable crops several chemical and bio-industries could be established in rural areas. Technical assistance projects in the area of biotechnology have been increasing, among which an important one is a project in the Philippines to establish a pilot plant for the enzymatic conversion of cellulose to ethanol.

2. Microelectronics

Activities in this field encompass international, regional and national levels.

(a) International level activities

In June 1981 a meeting of experts was organized on the implications of technological advances in microelectronics for developing countries. The meeting emphasized the importance of actions at the national level relating to manufacture; industrial and other applications; software development and the formulation of a national microelectronics strategy. Actions at the international level were also recommended, including a continuous monitoring of observed trends and their impact on various sectors, and the development of pilot projects and programmes dealing with applications and software.

Following the June 1981 meeting, a mission of experts visited four developing countries in different regions to promote selective applications of microelectronics and software development. Apart from reviewing the national situation in the countries visited, the mission recommended an approach to microelectronics application, including software and suggested models of microprocessor application centres and software houses. Also as a result of the June 1981 meeting, certain activities at the regional level were pursued. These are described in a later section.

A suggestion was made in the International Forum on Technological Advances and Development organized by UNIDO in Tbilisi, USSR in 1983 that an international centre for microprocessor applications should be established. As a starting point for examining the various requests for regional and international action, a series of country case studies have been initiated, aimed at the national level, but also to identify the scope for regional and international co-operation. It is expected that these studies will provide concrete information and meaningful approaches for regional and international action. Country studies published so far cover Bangladesh, Brazil, India, the Republic of Korea, Pakistan and Venezuela. An overview of the microelectronics industry in these countries has also been published. In addition, the concept of an international-silicon-foundry-cum-design-centre interacting with a network of national design centres has been prepared and has evoked interest in several quarters.

In an effort to promote co-operation among organizations and professional groups active in the area of information technology for development, the UNIDO secretariat convened a meeting in Vienna from 21 to 23 March 1984 which brought together representatives of selected groups, identified possible areas of co-operation and considered a mechanism for keeping mutually informed and for formulating joint programmes. In addition to representatives of organizations, selected specialists from developing countries were also invited to present their countries' policies and requirements. As a result of this meeting a Consultative Group on Information Technology (COGIT) has been established which will meet periodically to review ongoing activities, exchange experience and formulate joint programmes. A directory of these groups and organizations will also be prepared by UNIDO which will be updated as new organizations join COGIT.

The UNIDO secretariat has tried to promote the concept of software as an industry and the actions that developing countries could take to promote that industry. The concept has been elaborated through three studies dealing with (1) the importance of software for developing countries (2) the approach to software development in those countries (3) and guidelines for software production. Further work in this area will include the promotion and development of software for specific applications of relevance to developing countries, including applications in various industrial sectors. A report entitled "The commercialization of software: main issues and contractual terms and conditions" was prepared and submitted to the Ninth Meeting of Heads of Technology Transfer Registries. Through these efforts and by other means, it is proposed to build up a bank of application software for the benefit of developing countries.

Information technology, as covered by the term "informatics" and extending beyond data-bank systems and networks to industrial mangement tools and industrial processes, is in a stage of dynamic growth, particularly through the use of microprocessors. UNIDO co-sponsored a Conference on Informatics and Industrial Development with the Irish National Board for Science and Technology and Trinity College, Dublin, in March 1981. The Conference highlighted the importance developing countries attach to information developments, which are of substantial consequence to current industrial development strategies. UNIDO has also brought out a publication entitled "Informatics for industrial development".2/

(b) Regional-level activities

The UNIDO secretariat has been active in the promotion of regional-level attention and co-operation in the field of microelectronics in all the developing regions. An Expert Group Meeting for the Economic Commission for Latin America (ECLA) was held by UNIDO in June 1982 in Mexico, in co-operation with ECLA, at which the socio-economic implications of microelectronics advances for Latin American countries were analysed and a co-operative Latin American programme of action in the field of microelectronics was recommended. As a step in this direction, a Latin American Microelectronics Network including the Caribbean (REMLAC) was proposed following a high-level expert team mission to Venezuela in 1983. At the request of the Government of Venezuela, the experts looked at the facilities of an existing national institution in Venezuela with a view to upgrading it with UNIDO's assistance to become a nodal point for the proposed network. Other nodal points in different parts of the region will be identified. A meeting will take place in June 1985 in Caracas to establish REMLAC and to develop a programme of co-operation among the participating countries.

A Symposium on Microelectronics for Productivity, held at New Delhi in April 1983 and co-sponsored by UNIDO, requested UNIDO to take the lead in the promotion of the establishment of an Asian Centre for electronics. National-level studies in selected Asian countries have been undertaken to ascertain the needs for regional co-operation.

UNIDO has also co-operated with the Economic Commission for Western Asia (ECWA) in the preparation for and conduct of the Expert Group Meeting on the Development of Microelectronics in the ECWA Region, 4-7 March 1984, Kuwait.

2/ UNIDO/IS.415

Recommendations made at that meeting requested UNIDO, inter alia, to look into the possibility of establishing a silicon foundry with design facilities in the ECWA region. A UNIDO consultant undertook a preliminary mission in December 1984 which will be followed up by an in-depth study of the potentiality of future products in the countries of the region to assess the scope and potential for local manufacturing. Another co-operative effort between ECWA and UNIDO is the promotion of a CAD/CAM programme and its introduction in industry in the region. A report has been prepared by a UNIDO consultant.

With regard to Africa, UNIDO co-sponsored with the United Nations Conference on Science and Technology for Development (UNCSTD), the Organization of African Unity (OAU)and the Economic Commission for Africa (ECA) a meeting of African scientists on the implications of new technologies in the implementation of the Lagos Plan of Action and the Programme for the Industrial Development Decade for Africa. The meeting was held at Mbabane, Swaziland, from 22 to 26 October 1984. Activities in Africa are expected to arise as a follow-up to this meeting. A national meeting on applications of microelectronics and software was organized by UNIDO in Kenya from 18 to 23 February 1985. Representatives from countries in the region such as Ethiopia, Sudan, Tanzania, Uganda and Zambia also attended.

(c) National-level activities

At the national level, apart from the state-of-the-art studies commissioned, the UNIDO secretariat has been assisting the Government of Mexico in setting up a permanent national team to monitor technological advances through a project financed by the United Nations Financing System for Science and Technology for Development (UNFSSTD). Under this project a national-level workshop on microelectronics was held. Thereafter three experts specifically looked at the microelectronics industry in its several aspects and suggested, in the light of the technology trends in the world, the actions that the Government of Mexico could pursue.

A number of technical assistance projects are being implemented by UNIDO in fields such as semiconductor material technology, manufacture of integrated circuits, microprocessor applications, computer-aided design, numerically controlled machine tools.

Other activities in this field include: support to a training workshop in Brazil; studies on biomedical applications and power devices prepared on the basis of that workshop; a pilot project for a rural development information system in the state of Karnataka, India; a field study on computerization of small-scale industry in India; and optimization of sugar-cane processing in selected Latin American countries. A study on the use of computers for the organization of meat production and processing based on the experience gained from the system in the Philippines is under preparation.

The impact of microelectronics has been looked at in UNIDO's programme of industrial studies from the point of view of restructuring world industry. Two studies have been completed: "The impact of electronics on the international economic setting: the case of computer-aided design"3/,

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3/ UNIDO/IS.297

"Restructuring world industry in a period of crisis - the role of innovation: an analysis of recent developments in the semi-conductor industry".4/

A quarterly bulletin, the Microelectronics Monitor, has been published since January 1982 to create awareness and provide current information to a target audience of policy-makers, scientists and technologists, particularly in developing countries. A survey of technological and market trends during 1982 to 1983 was published in the Monitor.5/ A special supplement reviewing developments in flexible manufacturing systems (FMS) was published in February 1985.

3. Lighter-than-air technology systems

In 1981 UNIDO initiated activities concerning lighter-than-air (LTA) technology systems. While the technology of airships was already used several decades ago, current technological efforts have made it necessary, particularly in the face of rising energy costs, to examine the implications of LTA systems for developing countries. An expert group meeting studied the question in October 1981 and came to the conclusion that the current state of technological development and the limited operational experience in that field pointed to the need for a gradual approach on the part of the developing countries. Activities recommended by the meeting were therefore limited to support for a pilot project under way in Peru, as a means of gaining experience in LTA technology, and the issuance of a publication that would analyse and disseminate information on LTA systems. Possible activities in this respect in Africa are also under examination.

4. Space-related technologies

A study on the potential applications of space-related technologies for developing countries was presented by the UNIDO secretariat to the Second United Nations Conference on the Exploitation and Peaceful Uses of Outer Space in August 1982. The study showed, inter alia, that the "spin-off" of technologies developed for space programmes can have a variety of applications in several industrial fields which could contribute to the upgrading of technologies in those fields. The possibility of technology transfer in selected fields, particularly for small industries, is being explored further.

5. Marine technologies and sea-bed mining

In view of the implications of advances in marine technologies and in particular of sea-bed mining technologies for developing countries, studies from the point of view of industrialization were initiated in this sector. The studies made so far are "Technologies for investigation and exploitation of sea-bed resources: the potential for developing countries" and "Ocean mining and developing countries: an approach to technological disaggregation."

4/ UNIDO/IS.285

5/ UNIDO/IS.438

Proposals for joint activities for promoting the industrial and technological capabilities of developing countries in marine technologies in general have been under consideration in consultation with the Ocean Economics Branch of the United Nations, New York. A study on developments and trends in marine industrial technology was completed.

6. Materials

A series of studies on new materials and technologies has been initiated. A study on composites of possible relevance to developing countries has been completed while others on high-temperature ceramics and fibre optics are under preparation. A quarterly bulletin, Advances in Materials Technology:Monitor, has been started. Each issue of the Monitor will cover in some depth the state of the art in a specific group of materials. The first three issues of the monitor covered high-strength, low-alloy steels, high-temperature ceramics and fibre optics, respectively. The subject of materials and the policy implications for developing countries was also dealt with in the Expert Group Meeting on Technological Advances in Moscow in December 1982, and the International Forum on Technological Advances and Development in Tbilisi in April 1983. Papers on materials were also presented at both these meetings.

7. Other areas

Studies have been completed on long-term technological trends in the fields of machine tools and petrochemicals with special reference to their implications for developing countries. A study on the telecommunications industry in Brazil has been completed. A study of the telecommunications industry with special reference to developing countries has been initiated. A study on the telecommunications industry in Brazil was completed. In addition, studies on the long-term technological trends in selected industrial sectors are carried out by the Sectoral Studies Branch as part of the preparations for consultation meetings.

National-level mechanisms

The experience of UNIDO in the foregoing activities suggests that developing countries may have to individually and collectively set up monitoring mechanisms for assessing the implications of technological advances for their own development with reference to their specific conditions. Even countries at relatively early stages of development will need to possess a measure of technological awareness in an interdependent world. Interdisciplinary national mechanisms for this purpose will be required. Developing countries will also have to set up institutions and develop their technological capabilities in specific areas of technological advances so as to realize their potential for their unique requirements. In view of resource

and manpower constraints, countries at earlier stages of development may have to consider setting up small national groups in selected areas which could later develop into full-fledged institutions.

UNIDO assisted the Government of Mexico, through a project financed by the United Nations Financing System for Science and Technology for Development, intended to set up a permanent national team for monitoring technological advances and utilize the information generated thereby in policy- and decision-making. One of the results of the projects has been that a specific dimension of technological advances has been incorporated into the newly prepared industrial plan.

Consultancy services have been provided to the Government of Argentina to set up a monitoring mechanism in the field of microelectronics technology. Assistance to that country in the organization of a national workshop on technological advances in contemplated. The national technology policy workshops organized in Trinidad and Tobago (8 to 12 November 1983) and Malaysia (12 to 14 December 1983) also paid significant attention to the subject of technological advances.

Policy responses

In addition to work on specific technological advances, trans-sectoral aspects have been studied by UNIDO and an approach developed through a series of meetings, particularly the International Forum on Technological Advances and Development, held in Tbilisi in April 1983, which was preceded by an expert meeting held in Moscow in December 1982 and followed up by a Workshop on the Institutional and Structural Responses of Developing Countries to Technological Advances which was held in Dubrovnik, Yugoslavia, in May/June 1983.

The approach that has emerged is very briefly the following. The world technological scene is changing and there is a need for developing countries to rectify past deficiencies and to come to grips with the new situation. The emergence and convergence of technological advances are expected to affect a wide range of industrial sectors. Some of the technological advances have considerable potential for development of the developing countries, provided sufficient national and international efforts are undertaken. It is necessary for each country to reduce to a minimum the adverse consequences of the technological advances and to maximize the benefits through a selected and differentiated policy adapted to its own requirements. The technological advances need to be integrated into the existing and traditional technologies. Irrespective of the level of development each developing country needs a capacity to monitor and assess the implications of technological advances for its own development and to choose its own policy response in accordance with its conditions. In an interdependent world economy the impact of technological advances cannot be avoided and a timely and orderly response to them is of paramount importance. There is a need for a minimum level of competence to deal with emerging technologies within realistic time horizons and for establishing effective national groups for this purpose.

The approach which has crystallized through UNIDO's work was presented to the Fourth General Conference of UNIDO held in Vienna, Austria from 2 to 19 August 1984. In its resolution 2 the Conference recognized the considerable potential that high technology can have for industrial development of developing countries and recommended that developing

countries should establish appropriate means, individually and collectively, to forecast, monitor and assess technological trends and their implications for social and economic development and that they should formulate and implement policies to maximize the potential benefits of the new technologies and avoid their adverse consequences. It further recommended that developing countries should take into account technological advances in formulating integrated national technology policies. It asked UNIDO to assist developing countries in setting up national groups to monitor and assess technological trends and technical groups or institutions in selected technological advances and to continue to monitor world technology trends and the changing international technology market. It also asked UNIDO to assist interested countries on request in studies of ways and means for more efficient linkages and co-operation between national, regional and international centres for selected technologies including networks and in regard to identified gaps in the setting up of national, regional and international centres for selected technologies. The conference also asked UNIDO to promote an international referral system for the identification of high-level scientists and technologists.

Documentation

A bibliography of documents prepared by the UNIDO Technology Programme on the subject areas mentioned in the foregoing pages is attached to the present document as an annex. A large amount of analytical documentation on technological advances has been prepared by leading experts in various fields, examining the subject from the point of view of the developing countries.

Concluding remarks

The mobilization of international co-operation is an important instrument in assisting developing countries to respond to technological change. A significant degree of such mobilization has already taken place in genetic engineering and biotechnology through UNIDO's efforts to promote the establishment of an International Centre for Genetic Engineering and Biotechnology. A general scheme for the mobilization and co-operation of member institutions of the International Federation of Institutes of Advanced Study was also prepared. Following the recommendations of the Tbilisi and Dubrovnik meetings, an international roster of scientists and technologists in selected areas of technological advances is under compilation with the co-operation of the Committee on Science and Technology in Developing Countries (COSTED).

The UNIDO secretariat also chaired Working Group I of the Task Force on Science and Technology for Development of the Administrative Committee on Co-ordination on the specific subject of identification and assessment of scientific and technological advances. Through this mechanism UNIDO has also been able to contribute to greater efforts in the United Nations system as a whole to apply science and technology for the benefit of mankind.

Annex

List of documents compiled by the UNIDO Technology Programme on the implications for developing countries of technological advances in certain fields.

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GENETIC ENGINEERING AND BIOTECHNOLOGY

Genetic Engineering and Biotechnology Monitor. A quarterly newsletter.

G.E.4 Genetic Engineering and its Implications for Developing Countries: Some Preliminary Issues for Action.

G.E.5 Patentability of the Micro-Organisms and Implications in the Developing Countries.

CRP.1 Chemical Feedstocks from Renewable Resources in Developing Countries by J. Hollo.

CRP.2 What can Modern Biology Bring to Developing Countries? By A.I. Bukhari.

UNIDO Advisory Expert Panel on the Establishment of an International Centre for Genetic Engineering and Biotechnology
Vienna, Austria, 15-16 October 1981

UNIDO/IS.254 The Establishment of an International Centre for Genetic Engineering and Biotechnology (ICGEB). Report of a Group of Experts.

Exchange of Views with Experts on the Implications of Advances in Genetic Engineering for Developing Countries
Vienna, Austria, 4-6 February 1981

UNIDO/IS.259 Report on Exchange of Views with Experts on the Implications of Advances in Genetic Engineering for Developing Countries, 4-6 February 1981.

UNIDO/IS.260 Genetic Engineering: The Technology and its Implications by S.A. Narang.

UNIDO/IS.261 The Potential Impact of Microbiology on Developing Countries by Carl-Goran Heden.

UNIDO/IS.269 The Impact of Genetic Engineering on Industry.

UNIDO/IS.270/ Rev.1 Elements of Some National Policies for Biotechnology.

UNIDO/IS.271 Centres for Production of Enzymes by Sheikh Riazuddin.

UNIDO/IS.272 Commercialization of Genetic Engineering Technologies: Some Considerations.

UNIDO/IS.273 The Potential of Genetic Manipulation for the Development of Vaccines Against Animal Diseases in Developing Countries by W. Henderson.

National Workshop on the Potential of Genetic Engineering and Biotechnology for Environmental Health and the Petrochemical Industry
Kuwait, Kuwait, 11 January 1982

UNIDO/IS.321 National Workshop on the Potential of Genetic Engineering and Biotechnology for Environmental Health and the Petrochemical Industry. Report. Kuwait, 11 January 1982.

Exchange of Views with Experts on the Implications of Genetic Engineering and Biotechnology on Industrialization in Developing Countries
Calcutta, India, 6 January 1982,
New Delhi, India, 7-8 January 1982

UNIDO/IS.322 Report (Exchange of Views with Experts on the Implications of Genetic Engineering and Biotechnology on Industrialization in Developing Countries held at Calcutta, 6 January 1982 and New Delhi, 7-8 January 1982).

UNIDO/IS.336 Application of Biotechnology and Genetic Engineering to African Fermented Food Processes by Keith K. Steinkraus.

UNIDO/IS.450 The Application of Biotechnology in Developing Countries: The Case of Mineral Leaching with Particular Reference to the Andean Pact Copper Project by Alyson Warhurst.

UNIDO/IS.452 Biotechnology and the Developing Countries: Applications for the Pharmaceutical Industry and Agriculture.

UNIDO/IS.476 Enzymatic Conversion of Cellulosic Materials to Sugar and Alcohol: The Technology and its Implications.

UNIDO/IS.496 The Potential of Biotechnology for the Gulf Region and the Role of the International Centre for Genetic Engineering and Biotechnology.

UNIDO/IS/R.4 Genetic Engineering and Biotechnology in Egypt by David McConnell.

High-level Meeting on the Establishment of the International Centre for Genetic Engineering and Biotechnology
Belgrade, Yugoslavia, 13-17 December 1982

ID/WG.382/1 Draft Memorandum of Understanding and Guiding Principles of the International Centre for Genetic Engineering and Biotechnology.

ID/WG.382/2 and Corr.1 Five-year Work Programme of the International Centre for Genetic Engineering and Biotechnology.

ID/WG.382/2/Add.1 Selective Application of Advanced Biotechnology for Developing Countries by Carl-Goran Heden.

ID/WG.382/2/ Add.2	Application of Genetic Engineering for Energy and Fertilizer Production from Biomass by Ray Wu.
ID/WG.382/2/ Add.3	Hydrocarbon Microbiology with Special Reference to Tertiary Oil Recovery from Petroleum Wells by Ananda Chakrabarty.
ID/WG.382/2/ Add.4	Application of Genetic Engineering and Biotechnology for the Production of Improved Human and Animal Vaccines with Particular Reference to Tropical Diseases by Ahmad Bukhari and Ulf Pettersson.
ID/WG.382/2/ Add.5	Improved Agricultural and Food Products through Genetic E gineering and Biotechnology by David McConnel.
ID/WG.382/2/ Add.6	Bio-informatics by Carl-Goran Heden.
ID/WG.382/3	Proposed Budget of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.382/4	Considerations Related to the Location of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.382/7 and Corr.1	Report of the High-Level Meeting on the Establishment of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.384/4/ Rev.1	Genetic Engineering and Biotechnology and Developing Countries: Directions of Action.
ID/WG.384/13	Biotechnology and Enzymatic Conversion of Cellulose: Fundamentals and Applied Aspects by A.A. Klesov.

Ministerial-Level Plenipotentiary Meeting on the Establishment of the International Centre for Genetic Engineering and Biotechnology
Madrid, Spain, 7-13 September 1983

ID/WG.397/1 and Corr.1 and Corr.2	Report of the Selected Committee.
ID/WG.397/2	Financial Matters Relating to the International Centre for Genetic Engineering and Biotechnology.
ID/WG.397/3	Practical Considerations of the Operation and Work Programme of the International Centre for Genetic Engineering and Biotechnology by Burke K. Zimmerman.
ID/WG.397/4	Draft Statutes of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.397/4 Add.1	Proposed Options for the Assessment of the International Centre for Genetic Engineering and Biotechnology.

ID/WG.397/4/ Add.2	Annotations to the Draft Statutes of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.397/6	Organizational Matters.
ID/WG/397/8	Statutes of the International Centre for Genetic Engineering and Biotechnology.
ID/WG.397/9 and Add.1	Report (Meeting on Establishment of the International Centre for Genetic Engineering and Biotechnology).

Plenipotentiary Meeting on the Establishment of the International Centre for Genetic Engineering and Biotechnology
Vienna, Austria, 3-4 April 1984

ID/WG.421/2	Report of the Preparatory Committee to the Plenipotentiary Meeting.
ID/WG.421/3	List of Documents.
ID/WG.421/4	Conclusions of the Preparatory Committee at its Session Held on 3 April 1984 (ICGEB).
????	Some Aspects of Plant Biotechnology of Relevance to Africa.

MICROELECTRONICS

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ME 2	Application of Microelectronics for Development: Issues for Consideration by Sang Joon Hahn.
B.P.1	Future of Electronics and Technology Transfer by K.V. Ramanathan.
B.P.2	Large-Scale Integration: Intercontinental Aspects by Ian M. Mackintosh.
B.P.3	An Overview of the Electronics Industry in Europe by Ian M. Mackintosh.
B.P.4	From the Second to the Third Industrial Revolution by Gerard Lafay.
B.P.5	Semiconductor Industry and R and D in India by K.V. Ramanathan.
B.P.6	Policy and Planning of Computer Education by Shigeichi Moriguchi.
B.P.7	Experiences Around University Computer Centres by Shigeichi Moriguchi.

B.P.8 The Software Market - Conditioning Factors and Possible Future Trends. An Analysis Undertaken from a Third World Perspective by Dieter Ernst.

B.P.9 Potential Application of Computer Conferencing in Less Developed Countries by Carl-Goran Heden.

B.P.10 Implications of Microelectronics in Developing Countries by Mohammad Aslam.

B.P.11 Microelectronics and Employment by Ernest Braun.

B.P.12 Futures with Microelectronics by Ernest Braun.

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